MULTIMEDIA UNIVERSITY®

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 1, 2022/2023 (TERM ID 2215)**

## HCB1011 – CELL BIOLOGY

( All sections / Groups )

**13 FEBRUARY 2023**
**9.00 a.m. – 11.00 a.m.**
**(2 Hours)**

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**INSTRUCTIONS TO STUDENTS**

1. This Question paper consists of **6** pages with **4** Questions only.
2. Answer **ALL THE QUESTIONS**. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers **clearly** and **neatly** in the Answer Booklet provided.

## QUESTION 1

(a) Briefly, describe the "Primordial soup model" of life formation. [1 mark]

(b) For a science fair project, two students decided to repeat the Hershey and Chase experiment, with modifications. They decided to label the nitrogen of the DNA, rather than the phosphate. They reasoned that each nucleotide has only one phosphate and two to five nitrogens. Thus, labeling the nitrogens would provide a stronger signal than labeling the phosphates. Why won't this experiment work? [1 mark]

(c) Name the structure/organelle that provides the following functions: [3 marks]

i. Controls what passes in and out of the cell : _____

ii. Network of protein filaments that provides structural support : _____

iii. Packages proteins for export from the cell : _____

iv. Digests worn-out organelles and cell debris : _____

v. Organelle that produces most of the cell energy : _____

vi. Site of protein synthesis : _____

(d) What is the difference between rough endoplasmic reticulum and smooth endoplasmic reticulum? [2 marks]

(e) A doctor injects a patient with what the doctor thinks is an isotonic saline solution. The patient dies, and an autopsy reveals that many red blood cells had burst. Was the solution the doctor injected really isotonic? What is the tonicity of the solution? [1 mark]

(f) Cells were obtained from a patient with a viral infection. The DNA extracted from these cells consisted of two forms: **double-stranded human DNA** and **single-stranded viral DNA**. The base compositions of these two forms of DNA were as follows:

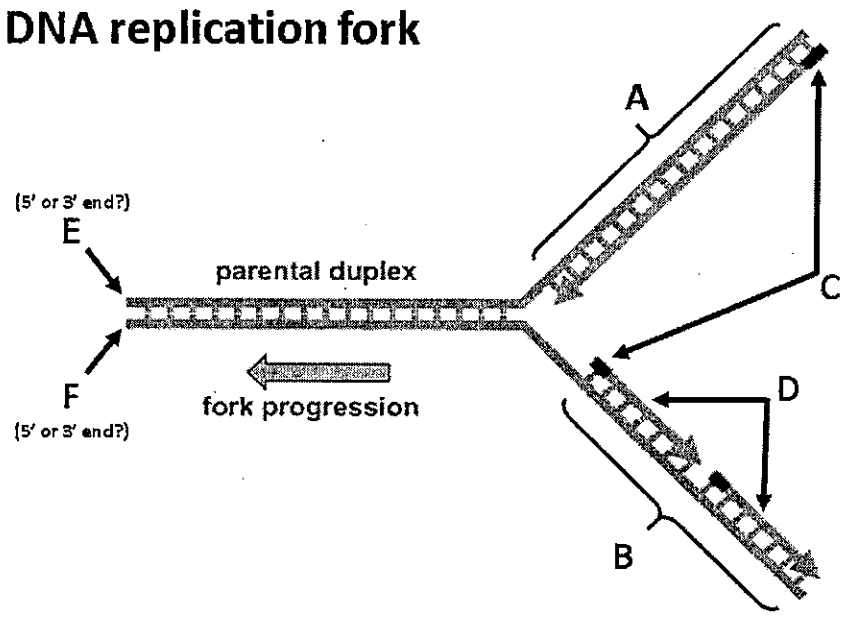
| | A | C | G | T |
|---|---|---|---|---|
| **DNA 1** | 22.1% | 27.9% | 27.9% | 22.1% |
| **DNA 2** | 31.3% | 31.3% | 18.7% | 18.7% |

Which form was the viral DNA, and which form was the human DNA? Explain your answer. [2 marks]

**Continued...**

## QUESTION 2

(a) Name the parts labelled as A, B, C, D, E and F: [3 marks]



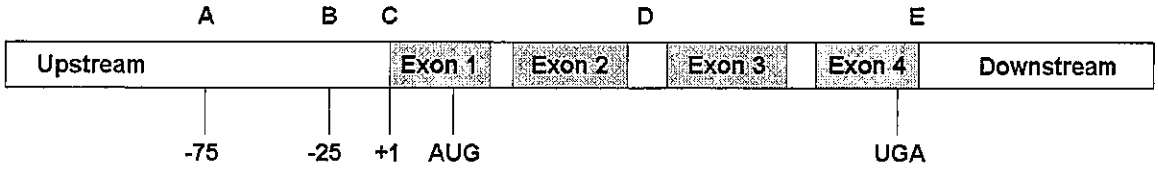

(b) Describe the "proof-reading" activity of DNA polymerase III in *E. coli*. [2 marks]

(c) State if the followings are TRUE or FALSE. [3 marks]

| | |
|---|---|
| i. | Messenger RNA is usually polycistronic in eukaryotes |
| ii. | Transcription factors function to help move ribosomes along the mRNA. |
| iii. | RNA processing occurs when amino acids are removed from nascent proteins. |
| iv. | A 3' poly-A tail and a 5'-cap are common components of prokaryotic RNAs. |
| v. | When one speaks of a 5'-cap, one is describing the addition of a base, usually thymine, to the 5' end of a completed peptide. |
| vi. | The triplet AUG is commonly used as a start codon during translation. |

**Continued...**

(d) This diagram represents regions around a gene encoding a mRNA. Exon 1 of the mRNA contains the translation initiation AUG codon. Exon IV contains the UGA termination codon. The letters A through E above the diagram refer to areas of the gene. [2 marks]




i. What region of the primary transcript is removed by a spliceosome?

ii. What region of the DNA contains the TATA box?

iii. Where is the poly (A) tail added to the transcript?

iv. Where is the 5' cap added to the transcript?

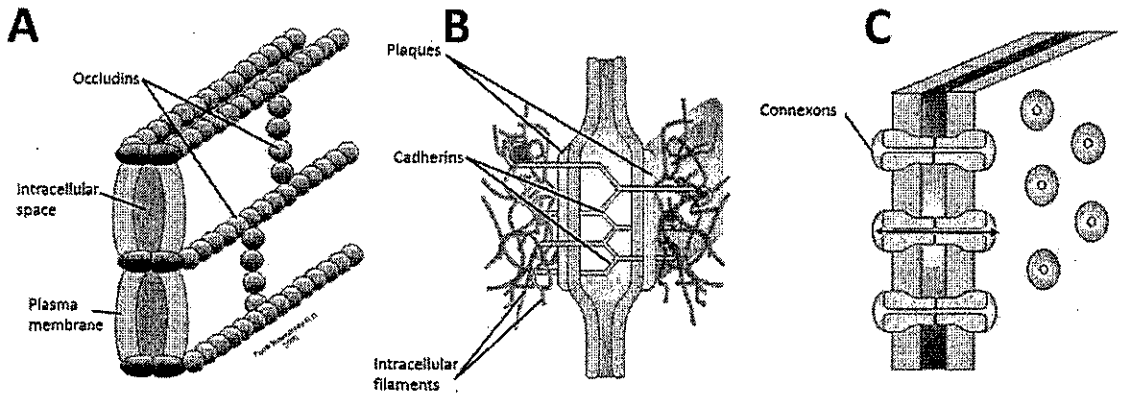
## QUESTION 3

(a) If mRNA is complementary to the DNA template strand and the DNA template strand is complementary to the DNA non-template strand, why are base sequences of mRNA and the DNA non-template strand not identical? Could they ever be? [1 mark]

(b) What is the role of chaperon proteins? [1 mark]

(c) What is the function of signal sequences on protein? [1 mark]

(d) Identify the type of cell junctions shown in the diagrams (A, B, and C) below: [3 marks]




**Continued...**

(e) Complete the following table using the codon chart provided. [4 marks]

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **DNA template strand** | | | | | | | | | | | |
| **DNA coding strand** | | | | | | | | | | T | G | A |
| **mRNA** | G | C | A | | | | | | | | |
| **tRNA** | | | | | | | G | C | A | | |
| **Amino acid** | | | | TRP | | | | | | | |

**Second Letter**

| 1st letter | U | | C | | A | | G | | 3rd letter |
|---|---|---|---|---|---|---|---|---|---|
| U | UUU | Phe | UCU | Ser | UAU | Tyr | UGU | Cys | U |
| | UUC | | UCC | | UAC | | UGC | | C |
| | UUA | Leu | UCA | | UAA | Stop | UGA | Stop | A |
| | UUG | | UCG | | UAG | Stop | UGG | Trp | G |
| C | CUU | Leu | CCU | Pro | CAU | His | CGU | Arg | U |
| | CUC | | CCC | | CAC | | CGC | | C |
| | CUA | | CCA | | CAA | Gln | CGA | | A |
| | CUG | | CCG | | CAG | | CGG | | G |
| A | AUU | Ile | ACU | Thr | AAU | Asn | AGU | Ser | U |
| | AUC | | ACC | | AAC | | AGC | | C |
| | AUA | | ACA | | AAA | Lys | AGA | Arg | A |
| | AUG | Met | ACG | | AAG | | AGG | | G |
| G | GUU | Val | GCU | Ala | GAU | Asp | GGU | Gly | U |
| | GUC | | GCC | | GAC | | GGC | | C |
| | GUA | | GCA | | GAA | Glu | GGA | | A |
| | GUG | | GCG | | GAG | | GGG | | G |

**Continued...**

## QUESTION 4

(a) Define totipotent, pluripotent, and multipotent stem cells. Give ONE example of each cell type. [3 marks]

(b) Identify the term that does not belong in each of the following groups, and briefly explain why it does not belong. [4 marks]

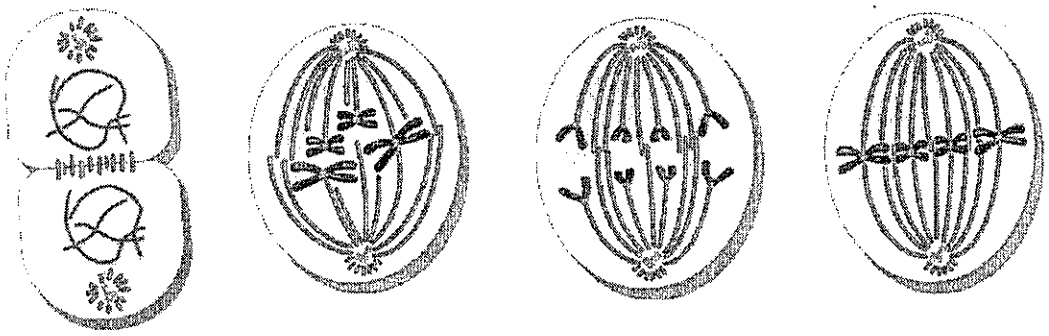
i. G1 phase, G2 phase, S phase, Telophase

ii. Anaphase, interphase, metaphase, prophase

iii. Binary fission, mitosis, meiosis, cytokinesis

iv. Centrioles, vesicles, kinetochore fibers, polar fibers

(c) Name the phases of mitosis shown in the figures (A, B, C, and D) below: [2 marks]



A B C D

(d) How does telomerase make a cancer cell immortal? [1 mark]

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